



(REVIEW ARTICLE)



## The transformative impact of the mediterranean diet and physical activity on Alzheimer's disease

Maria Gisele dos Santos \* and Miguel Carlos Freitas

*Department of Physical Education, Federal University of Paraná, Brazil.*

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### Abstract

Alzheimer's Disease (AD) is a neurodegenerative condition that affects millions of people worldwide, being responsible for most cases of dementia. This disease, characterized by progressive cognitive decline, significantly impacts the quality of life of patients and their families. Amid the search for effective treatments, non-pharmacological interventions, such as the Mediterranean diet and physical activity, emerge as promising approaches for the prevention and management of Alzheimer's.

**Mediterranean Diet: Nutrition for Brain Health:** The Mediterranean diet, which originates from countries such as Greece, Italy, and Spain, is recognized for its balanced dietary pattern, consisting of foods rich in neuroprotective nutrients. Among its main components are fruits, vegetables, whole grains, olive oil, fish, nuts, and red wine in moderation. These foods provide antioxidants, omega-3 fatty acids, vitamins, and polyphenols, which are essential for fighting oxidative stress and inflammation in the brain.

Scientific research shows that adherence to the Mediterranean diet is associated with a lower risk of developing Alzheimer's and other neurodegenerative diseases. Individuals who strictly follow this dietary pattern are 40% less likely to develop dementia compared to those who consume Western diets, rich in saturated fats and refined sugars.

The antioxidant role of the diet is critical for brain health, as it reduces damage caused by free radicals. Omega-3 fatty acids, present in fatty fish such as salmon and tuna, are known to promote synaptic plasticity and communication between neurons. In addition, olive oil, rich in anti-inflammatory compounds, helps protect nerve cells against inflammatory processes that contribute to the progression of AD.

**Physical Activity: Movement and Neuroprotection:** Regular physical exercise is an equally effective intervention in combating brain degeneration. Exercise, especially aerobics, promotes neurogenesis in the hippocampus, a region responsible for memory and learning, showed that regular exercise increases hippocampal volume in older adults, slowing cognitive decline.

Longitudinal studies, such as the one indicate that physical activity improves executive functions, memory, and attention in older adults with mild cognitive impairment. In addition, exercise reduces metabolic risk factors, such as obesity, hypertension, and diabetes, which are directly associated with the progression of AD. Point out that up to a third of Alzheimer's cases could be avoided through interventions aimed at reducing these factors.

**Keywords:** Mediterranean diet; Physical activity; Alzheimer's disease; Cognitive impairment

\* Corresponding author: Maria Gisele dos Santos

## **1. Introduction**

Alzheimer's Disease (AD), characterized by the progressive degeneration of cognitive functions such as memory, language, and judgment, has become one of the most challenging health conditions today, especially in aging populations. It is estimated that more than 50 million people in the world live with some type of dementia, with Alzheimer's accounting for approximately 60% to 70% of cases (WHO, 2020). The progression of the disease, which has not yet been definitively cured, has a significant impact on the quality of life of individuals, their families, and health systems. In this scenario, the adoption of preventive strategies and non-pharmacological interventions has gained prominence, with the Mediterranean diet and physical activity emerging as effective and scientifically supported approaches.

### **1.1. The Impact of Alzheimer's Disease on Global Health**

Increased life expectancy, coupled with factors such as medical advances and better hygiene, has contributed to global population aging. As a result, the prevalence of chronic diseases, including dementias, has increased exponentially. AD not only affects cognition, but also emotional and functional aspects, compromising the patient's independence and requiring intensive care. According to Alzheimer's Disease International (2019), the global cost of dementia exceeds US\$ 1 trillion per year, evidencing the need for effective interventions to slow the progression of the disease.

### **1.2. Mediterranean Diet: A Nutritional Approach to Brain Health**

The Mediterranean diet, traditionally followed by populations in southern Europe, is recognized for its nutritional composition rich in antioxidants, monounsaturated and polyunsaturated fatty acids, fiber, and polyphenols. This dietary pattern includes high consumption of fruits, vegetables, whole grains, nuts, olive oil, fish, and legumes, with moderate intake of red wine, and a low proportion of red meat and processed products. The relevance of this diet on brain health is widely supported by scientific literature. According to Scarmeas et al. (2006), adherence to the Mediterranean diet is associated with a 40% reduced risk of developing AD compared to Western diets rich in saturated fats and refined sugars.

The Mediterranean diet contributes to neurological health through several mechanisms. First, its antioxidant compounds, such as vitamin E, flavonoids, and resveratrol, counteract free radical damage in the brain, one of the factors implicated in neurodegeneration (Tangney et al., 2011). In addition, the consumption of omega-3 fatty acids, present in fish such as salmon and sardines, promotes synaptic plasticity and reduces inflammation, essential processes for the preservation of cognitive functions (Cederholm et al., 2013).

### **1.3. Physical Activity: Movement for the Benefit of Cognition**

In addition to food, regular physical activity is widely recognized as a protective factor against brain degeneration. Aerobic exercises, such as walking and swimming, as well as muscle-strengthening activities, have been shown to be effective in reducing cognitive decline and improving executive function in older adults. Neurogenesis, i.e., the formation of new neurons, is one of the main benefits attributed to physical exercise, especially in the hippocampus, a region of the brain directly affected by Alzheimer's (Erickson et al., 2011).

Longitudinal studies reinforce the relationship between physical activity level and cognitive health. For example, Lautenschlager et al. (2008) reported that older adults with mild cognitive impairment who participated in a regular exercise program showed a significant improvement in memory and attention compared to the control group. In addition, the practice of physical activities contributes to the reduction of cardiovascular risk factors, such as hypertension and diabetes, which are closely related to the development of dementia (Barnes & Yaffe, 2011).

### **1.4. Synergy between Mediterranean Diet and Physical Activity**

Although the benefits of the Mediterranean diet and physical activity are often investigated separately, recent studies highlight the synergistic effect of these interventions in the prevention and management of Alzheimer's. When combined, these factors enhance neuroprotection, promote neural regeneration, and reduce systemic inflammation, creating an environment favorable to brain health. Adherence to a healthy lifestyle, which includes balanced eating habits and regular exercise, can significantly delay the onset of AD symptoms and improve the quality of life of patients.

A study conducted by Sofi et al. (2011) demonstrated that individuals who simultaneously adhered to the Mediterranean diet and a regular exercise program had better performance on cognitive tests and less accumulation of beta-amyloid plaques, one of the pathological markers of AD. These findings reinforce the need to promote integrated interventions as part of public health policies.

### 1.5. Objective of the Study

This article seeks to explore the benefits of the Mediterranean diet and physical activity for people with Alzheimer's, based on a comprehensive review of scientific literature. The underlying biological mechanisms, the clinical impacts of both interventions, and the future prospects for their large-scale implementation will be discussed. The analysis is based on the premise that Alzheimer's should not be treated just as an isolated medical condition, but as part of a holistic approach that integrates physical, mental, and social health.

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## 2. Literature review

### 2.1. Introduction to the Topic

Alzheimer's disease (AD), one of the leading causes of dementia worldwide, is characterized by progressive loss of memory and cognitive functions, affecting millions of people. According to the World Health Organization (WHO, 2020), the global prevalence of AD has increased with the aging of the population, becoming a serious public health problem. While pharmacological treatments have limited efficacy, non-pharmacological interventions, such as the Mediterranean diet and physical activity, emerge as promising approaches to delay the onset and progression of the disease.

These practices not only offer neuroprotective benefits but also improve the quality of life of patients and caregivers. Studies highlight that the synergistic effect between balanced nutrition and physical exercise can play a crucial role in preserving cognitive function (Scarmeas et al., 2006; Lautenschlager et al., 2008).

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## 3. Mediterranean Diet and Brain Health

### 3.1. Nutritional Composition and Protection Mechanisms

The Mediterranean diet is recognized for its composition rich in whole foods and bioactives. Among its main components are fruits, vegetables, whole grains, olive oil, fish, nuts, and red wine consumed moderately. These foods provide antioxidants, unsaturated fatty acids, and anti-inflammatory compounds, which are essential for protecting the brain from oxidative and inflammatory damage.

Tangney et al. (2011) identified that the polyphenols present in olive oil and red wine are potent neutralizers of free radicals, helping to preserve the integrity of nerve cells. In addition, omega-3 fatty acids, found in fish such as salmon and sardines, play an essential role in the formation of neuronal membranes and synaptic plasticity (Cederholm et al., 2013).

### 3.2. Scientific Evidence

Epidemiological studies reinforce the association between adherence to the Mediterranean diet and reduced risk of Alzheimer's. In a longitudinal study, Scarmeas et al. (2006) followed 2,258 participants for 4 years and found that those who strictly followed this dietary pattern had a 40% reduction in the risk of developing dementia.

Clinical trials also corroborate these findings. Martínez-Lapiscina et al. (2013) demonstrated that patients who adhered to the Mediterranean diet supplemented with extra-virgin olive oil showed improvements in memory and global cognition.

### 3.3. Neuroprotection and Diet

*3.3.1. The brain protective mechanisms of the Mediterranean diet are widely studied. These include:*

- Reduction of oxidative stress: Antioxidant compounds neutralize free radicals (Tangney et al., 2011).
- Modulation of inflammation: Unsaturated fatty acids reduce systemic inflammation (Cederholm et al., 2013).
- Prevention of beta-amyloid plaques: Studies suggest that certain compounds in the diet may inhibit the formation of these plaques, a key marker of Alzheimer's (Mattson, 2012).

## 4. Physical Activity and the Prevention of Alzheimer's

### 4.1. Neurocognitive Benefits

Regular physical exercise has shown significant benefits in maintaining brain health. Erickson et al. (2011) showed that aerobic activities increase the volume of the hippocampus, a region essential for memory, slowing cognitive decline.

In addition, physical activity promotes neurogenesis, i.e., the formation of new neurons, and increases synaptic plasticity, critical factors for the preservation of cognition (Gomez-Pinilla & Hillman, 2013).

### 4.2. Longitudinal Evidence

Lautenschlager et al. (2008) investigated the impact of physical exercise on older adults with mild cognitive impairment. The study showed that participants who performed physical activities regularly showed a significant improvement in memory and attention compared to the control group.

Barnes and Yaffe (2011) estimated that up to one third of Alzheimer's cases could be avoided through interventions aimed at reducing risk factors, such as hypertension, obesity and sedentary lifestyle.

### 4.3. Reduction of Risk Factors

4.3.1. *Exercise also reduces metabolic risk factors associated with Alzheimer's, such as:*

- High blood pressure: Controlled through regular exercise (Barnes & Yaffe, 2011).
- Type 2 diabetes: Significant reduction with aerobic physical activity (Mattson, 2012).
- Obesity: Prevention of visceral fat accumulation, which negatively impacts cognition (Gomez-Pinilla & Hillman, 2013).

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## 5. Integrated Approach: Diet and Exercise

### 5.1. Combined Studies

Recent studies show that the combination of Mediterranean diet and physical activity enhances the benefits for cognitive health. Sofi et al. (2011) conducted a meta-analysis that showed that individuals who simultaneously adhered to these interventions had a lower risk of cognitive decline and lower formation of beta-amyloid plaques.

### 5.2. Neuroprotective Synergy

5.2.1. *The synergy between diet and exercise occurs because:*

- The diet provides essential nutrients for cell regeneration.
- Physical exercise stimulates metabolic processes that facilitate the elimination of toxins and neurogenesis.

### 5.3. Clinical Implementation

Although the benefits of these practices are widely recognized, their implementation in clinical practice is still limited. Petersen et al. (2018) highlighted that integrated diet and exercise programs should be personalized, considering the physical and cognitive limitations of patients.

The scientific literature offers robust evidence that the Mediterranean diet and physical activity are effective interventions for the prevention and management of Alzheimer's. These practices not only slow cognitive decline but also improve patients' quality of life and reduce the socioeconomic impact of the disease.

Investments in awareness programs, personalization of interventions, and additional research are needed to integrate these practices into public health and clinical care policies.

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## 6. Conclusion

Analysis of the relationship between the Mediterranean diet, physical activity, and Alzheimer's Disease (AD) reveals a holistic and promising approach to the prevention and management of this neurodegenerative condition. This work

detailed the biological mechanisms, scientific evidence, and practical applications of these interventions, demonstrating how they can transform the lives of individuals affected by this disease and their families.

- Mediterranean Diet as a Nutritional Pillar the Mediterranean diet, with its antioxidant-rich foods, unsaturated fatty acids, and anti-inflammatory compounds, offers a potent biochemical arsenal for protecting the brain from damage caused by oxidative stress and inflammation. Studies, such as those, by have shown that adherence to this dietary pattern is associated with a significant reduction in Alzheimer's risk and cognitive decline. In addition, the benefits go beyond brain health, promoting better cardiovascular health, which is also essential for the prevention of dementia.
- Physical Activity as a Cognitive and Functional Intervention Regular physical exercise is essential not only for physical well-being, but also for the maintenance and improvement of cognitive functions in people with Alzheimer's. Longitudinal studies, such as those, have highlighted the ability of physical activity to promote neurogenesis, especially in the hippocampus, and to reduce metabolic risk factors associated with AD. These findings reinforce the role of movement as a crucial strategy for non-pharmacological intervention.
- Synergy between Diet and Exercise The combination of a balanced diet and regular exercise amplifies the benefits for brain health. Research such as that has shown that individuals who adopt both practices have better cognitive performance and a lower risk of developing dementia. This synergy reflects the need for integrated approaches that consider lifestyle, rather than isolated interventions.

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## Compliance with ethical standards

### *Disclosure of conflict of interest*

No conflict of interest to be disclosed.

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